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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1985

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INTRODUCTION

Tomatoes are the most important processed crop in Ohio with a harvested acreage in 1985 of 15,800 acres and about 379,200 ton production,which was slightly down from 1983. Yield was projected to average 24 tons per acre; this is down slightly from the record high yield of 24.5 tons in 1984. Harvest in Ohio started in the central part of the state, the last week of July. By September 1, nearly 40 percent of the crop had been harvested with excellent quality. Weather conditions were near ideal and rains timely through the season. New planting practices, growing methods, machine harvest-bulk handling and new processing technology require a continuous supply of better suited varieties in order that the industry be competitive with other production areas. Ohio remains by far the second largest processing tomato production state.

This breeding work continues to be directed with emphasis on improvement of the whole-canned tomato (whole-pack) and diced tomato product. Other needs of the canner are being given attention in relation to these products, as well as development of improved varieties for the processor of juice, sauce and paste products.

Selection for earliness and improved fruit setting ability, especially during periods of heat stress, is being carried out to reduce the problem of split fruit set and make possible more uniform harvest-delivery schedules. With increased direct seeding, greater emphasis is being given to seed germination cold tolerance. Other important characteristics being selected to make machine harvest and bulk handling more efficient include crack resistance, firmness and ability of ripe fruit to store well on the vine for extended periods to allow maximum usable ripe fruit recovery in once-over harvest. Thus, in addition to increased productivity, a major objective is more effective utilization of yield already being attained, especially in regard to factors minimizing losses, due to overripe, rotted and green fruit. Jointless pedicel (j2) is being utilized to facilitate machine harvest and allow delivery of fruit free of stems.

Improved quality factors being selected for and intensively evaluated for in cooperation with commercial processors include: acidity, pH, soluble solids, viscosity, color (crimson fruit color [og^c] and high pigment fruit color [hp]), vitamin C, and especially fruit attributes conditioning efficient lye or steam peeling characteristics, corelessness and high case yield.

Professor, Assistant Professor, Agricultural Technician, Branch Manager, and Agricultural Aide

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For the 1985 season, there was a major increase in planted acreage of the early-main season Verticillium-Fusarium resistant, machine harvest cultivar Ohio 7870. It continued to exhibit excellent productivity and especially good fruit disease resistance and holding ability. Commercial yields of Ohio 7870 were excellent in hand, as well as machine harvest. It exhibited good adaptability for the production of whole-canned coreless and diced product, as well as in pureed product. Reports on quality continued to be excellent. Acreage of Ohio 7870 is increasing in Ohio, as well as surrounding midwestern and eastern states where it has already become a major variety.

The early-main season Verticillium and Fusarium resistant variety Ohio 7681 also continues to be grown extensively and is used exclusively for processed product.

The acreage of Ohio 7814 increased. It is proving to be a valuable asset as an early-main season Fusarium resistant, jointless pedicel, machine harvest type with excellent firmness, holding ability, and resistance to fruit rots. It is especially suitable for coreless wholepack and diced pack, as well as pureed products. Yields and quality through the Midwest and Canada were excellent and acreage of Ohio 7814 will increase in 1986.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, fall bedded, November 1984.

Fertilizer: 800 lb. per acre of 0-26-26, November 19; 205 lb. per acre of 34-0-0, April 29.

Herbicide: Devrinol 1 1/2 lb. ai May 13; Sencor directed spray 0.38 lb. ai June 14.

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 9.

Transplanted to Field: May 20, a two-row transplanter using 21-53-0 starter at 5 lb. per 100 gal. of water; 1/2 pint per plant.

Plot Size and Spacing: One-row plots, 20 plants per row spaced 12 inches, rows 5 feet apart; Trial I, 4 replications; Trial II, 2 replications.

Insect and Disease Control: Standard recommended program followed for insect and disease control.

Weather Data (Fremont, Ohio)

	Temperature		Rainfall (inches)	
	1985	31 Yr. Avg.	1985	31 Yr. Avg.
April	54.9	48.3	0.96	3.11
May	62.1	58.8	3.63	3.46
June	64.9	68.1	1.96	3.95
July	71.2	72.3	2.69	3.97
August	68.1	70.3	3.79	3.52
September	64.2	63.9	0.96	2.94

Excellent weather conditions characterized the planting period and moderate temperatures along with timely rains were experienced through most of the growing season. These conditions helped insure high yields. Excellent conditions at harvest allowed delivery to the processor of a high quality crop.

HARVEST INFORMATION

Harvesting was with an FMC Tomato Harvester and was carried out when the entries were estimated to be at a stage of fruit ripeness in which yields of marketable fruit were approaching optimum recovery with a minimum of green and cull fruit (Tables 1 & 4). Percentages reported of fruit recovery are on a weight basis.

QUALITY EVALUATION

Field-run tomatoes were used for quality evaluation; the sample was cut in half, quartered, extracted in a Food Processing Equipment Co. Laboratory pulper, and de-aerated. All laboratory samples were harvested by hand on August 27 and evaluated the following day (Tables 2 & 4).

1. Agtron E-5. Instrument calibrated at 48.
2. Hunter D-6 Tomato colorimeter (TCM).
3. Percent Soluble Solids. Abbe Refractometer
4. Percent Total Acid as citric. The raw sample used for pH determination was directly titrated using 0.1 normal sodium hydroxide solution to a pH of 8.1.
5. pH was determined by the glass electrode method.

RESULTS

The data for the new experimental lines is organized according to maturity groups and within maturity by once-over machine-harvest fruit yield (Tables 1 & 3). Because of the complexity of factors which determine a potentially successful variety, other factors which must be considered and that can be limiting are included; eg., fruit concentration, fruit cull percentage, fruit size, stemming character, jointlessness, and the quality characteristics of pH, acidity, soluble solids and color (Tables 2 & 4). It must be stressed that to adequately evaluate these lines at least one or two more years of testing will be necessary.

The Ohio 832 was released by The Ohio State University-OARDC in 1985. It is a main-season-early Verticillium-Fusarium resistant F6 selection, which has demonstrated excellent potential. Fruit have the crimson ($\underline{og}^{C}$) color, and are deep square, about 95 g, uniform ripening ($\underline{u}$), crack resistant with good vine storage. Plants are determinate ($\underline{sp}$) with compact semi-upright growth habit, which at maturity becomes semi-prostrate and concentrated. It is resistant to Fusarium wilt ($\underline{I}$) and Verticillium wilt ($\underline{Ve}$). It is being utilized for sauce, juice, catsup, diced product and whole-pack and continues to exhibit improved processing color, solids and viscosity. Commercial acreage for Ohio 832 is already extensive through the midwest, east and Canada and this will be increasing in 1986.

The Ohio 8129 continues to exhibit excellent potential in commercial plantings. It is an early-main-season machine harvest jointless pedicel type suitable for wholepack or processed product. Commercial seed lots are available.

The Ohio 7983 has been extensively evaluated and is very promising as an early, high quality machine harvest jointless pedicel wholepack type. It has exhibited greatest potential in Canada.

The Ohio 8243 and 8245 are both productive early main-season, jointless pedicel, machine harvest lines with Fusarium and Verticillium wilt resistance. They are suitable for coreless wholepack, as well as processed product. There will be extensive trial commercial acreage of these lines in 1986 and commercial seed is available.

This season the newly advanced lines Ohio 8239 and 8383, especially excelled for improved earliness, productivity, disease resistance and quality; these will be more fully evaluated in 1985 Research Center, as well as commercial grower-processor trials.

Newly advanced lines with Bacterial Speck resistant Ohio 8438, 8439, 8442, 8444, and 8446 continued to exhibit good potential and will be advanced to grower trials in 1986 and seed increased.

Seed Sources and Cooperators

1. S.Z. Berry, Dept. of Horticulture, OSU-OARDC, Wooster, OH.
2. W.S. Taylor, Campbell Soup Co., Campbell Institute for Agricultural Research, Napoleon, OH.
3. F. Cortelyou, Hunt-Wesson Foods, Inc., Perrysburg, OH.
4. D. Ematty, H.J. Heinz Co., 13737 Middleton Pike, Bowling Green, OH
5. C. Nichols, Ferry-Morse Seed Co., San Juan Bautista, CA.

TABLE 1. Trial I. Field evaluation of processing tomato varieties and test lines for mechanical harvest when yields of marketable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1985.

Variety or Test Line	Ripe Usable Tons/A	Ripe Usable % of Potential	% of Potential Cull	Fruit Size (oz)	Stems %	Stems (j2-jointless) (+-jointed)
Harvest Date 8/29/85						
Easy Winner	21.2	72	4	2.9	2	j2
Harvest Date 9/4/85						
Ohio 8129	38.1	83	5	2.4	0	j2
Ohio 8464	32.6	81	6	2.4	0	j2
Ohio 8477	30.7	76	7	3.2	1	j2
Ohio 8431	30.4	67	6	2.5	0	j2
Ohio 8471	26.9	78	9	3.2	0	j2
Ohio 8442	25.6	81	8	2.4	0	j2
Ohio 8460	25.6	63	8	3.2	0	j2
Heinz 2653	24.9	82	11	2.3	1	j2
Harvest Date 9/10/85						
Ohio 8243	44.4	81	8	2.1	0	j2
Ohio 8358	37.2	78	4	2.4	0	j2
Ohio 8550	37.2	76	10	3.1	0	j2
Ohio 8374	36.8	76	12	2.7	0	j2
Ohio 8297	36.7	80	6	3.1	0	j2
Ohio 8439	36.3	78	11	2.9	0	j2
Ohio 8456	35.8	75	12	2.8	1	j2
Ohio 8363	35.4	81	4	2.6	0	j2
Ohio 7814	34.8	83	10	2.3	0	j2
Ohio 8383	34.5	75	16	3.3	2	j2
Ohio 8245	33.2	79	4	2.5	0	j2
Heinz 722	33.0	75	6	2.2	0	j2
FM 6203	32.7	82	11	3.0	12	+
Ohio 8444	32.6	76	12	2.7	2	j2
Ohio 832	31.6	80	9	3.6	35	+
Ohio 8445	31.2	81	11	2.5	14	j2
Ohio 8449	30.8	83	8	2.7	20	j2
Ohio 8239	30.6	75	14	2.7	0	j2
Harvest Date 9/19/85						
Ohio 7983	29.8	78	18	2.4	0	j2
Ohio 7870	28.8	74	16	2.8	36	+
LSD 5%	5.9	5	4	0.4	8	

TABLE 2. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, Ohio, 1985.

Variety or Test Line	pH	% Citric acid	% Soluble solids	Color		
				Hunter CDM a/b	Hunter D6 TCM	Agtron E5
Easy Winner	4.61	0.31	4.8	2.59	77	32
Ohio 8129	4.47	0.37	4.6	2.59	72	31
Ohio 8446	4.18	0.43	5.4	2.31	68	30
Ohio 8477	4.52	0.35	4.6	2.76	75	27
Ohio 8431	4.55	0.34	5.0	2.76	79	31
Ohio 8471	4.64	0.32	4.5	2.60	76	28
Ohio 8442	4.33	0.32	5.1	2.26	70	31
Ohio 8460	4.50	0.37	5.8	2.59	78	29
Heinz 2653	4.54	0.32	4.7	2.60	74	31
Ohio 8243	4.46	0.34	4.5	2.41	72	32
Ohio 8358	4.44	0.36	4.6	2.42	71	31
Ohio 8550	4.19	0.34	5.1	2.52	72	29
Ohio 8374	4.56	0.30	4.5	2.42	70	33
Ohio 8297	4.49	0.32	5.2	2.43	70	33
Ohio 8439	4.50	0.33	4.9	2.50	70	32
Ohio 8456	4.40	0.47	5.6	2.34	74	33
Ohio 8463	4.45	0.37	4.8	2.50	72	31
Ohio 7814	4.50	0.33	4.3	2.56	73	32
Ohio 8383	4.51	0.36	4.5	2.65	74	29
Ohio 8245	4.41	0.42	4.6	2.48	71	30
Heinz 722	4.52	0.35	4.6	2.49	70	30
FM 6203	4.53	0.33	4.2	2.47	72	32
Ohio 8444	4.35	0.55	5.2	2.40	68	30
Ohio 832	4.52	0.30	4.3	2.70	79	30
Ohio 8445	4.20	0.33	5.2	2.44	73	29
Ohio 8449	4.52	0.36	4.5	2.49	74	31
Ohio 8239	4.51	0.28	4.0	2.50	71	33
Ohio 7983	4.45	0.36	4.6	2.41	71	33
Ohio 7870	4.54	0.32	4.8	2.59	68	31

TABLE 3. Trial II. Field evaluation of processing tomato varieties and test lines for mechanical harvest when yields of marketable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1985.

Variety or Test Line	Ripe Usable Tons/A	Ripe Usable % of Potential	% of Potential Cull	Fruit Size (oz)	Stems %	Stems (j2-jointless) (+-jointed)
Harvest Date 8/29/85						
Ohio 85132	22.2	73	10	2.8	3	j2
Harvest Date 9/4/85						
Ohio 85134	38.6	79	7	2.7	0	j2
Ohio 8582	35.0	82	9	2.7	0	j2
Ohio 85110	32.7	78	9	3.1	0	j2
Ohio 85118	31.0	73	15	2.6	0	j2
Ohio 85136	31.0	79	10	2.5	0	j2
Ohio 8560	30.5	78	10	2.9	13	+
Ohio 8597	29.9	85	5	2.4	0	j2
Ohio 85107	28.7	83	8	2.9	0	j2
Ohio 85135	28.5	79	6	2.9	0	j2
Ohio 85120	28.3	89	4	2.8	23	+
Ohio 85106	27.6	71	18	2.9	0	j2
Ohio 85131	27.1	79	13	2.5	0	j2
Ohio 85115	26.5	80	12	3.1	9	+
Ohio 832	24.9	76	10	3.1	26	+
Heinz 2653	23.7	87	8	2.3	2	j2
Harvest Date 9/10/85						
Ohio 8575	36.2	77	8	2.6	0	j2
Hunt H27266	34.5	65	11	4.1	37	+
Ohio 8556	32.9	81	15	3.0	0	j2
Ohio 7870	31.7	78	10	2.8	24	+
Ohio 7814	30.3	82	11	2.0	0	j2
Ohio 8576	30.2	79	15	3.3	39	+
Ohio 85123	30.2	75	15	2.6	0	j2
Ohio 85138	30.1	78	11	2.7	0	j2
Ohio 8572	29.0	78	12	2.5	0	j2
Ohio 8588	29.0	77	17	2.6	0	j2
Ohio 8555	27.4	79	11	3.1	2	j2
Ohio 85112	26.3	73	24	2.8	0	j2
Ohio 8567	26.0	75	15	2.6	1	j2
Ohio 8558	25.7	76	15	2.9	16	+
Ohio 8599	24.7	74	16	2.9	2	j2
Ohio 8553	22.6	66	16	3.5	28	+
Hunt H29856M	22.5	67	23	3.0	8	+
LSD 5%	9.3	10	7	0.4	5	

TABLE 4. Trial II. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, Ohio, 1985.

Variety or Test Line	pH	% Citric acid	% Soluble solids	Color		
				Hunter CDM a/b	Hunter D6 TCM	Agtron E5
Ohio 85132	4.40	0.38	4.3	2.71	73	31
Ohio 85134	4.51	0.31	4.9	2.67	73	30
Ohio 8582	4.59	0.32	4.8	2.47	71	32
Ohio 85110	4.55	0.25	4.3	2.46	73	29
Ohio 85118	4.70	0.30	5.0	2.48	69	31
Ohio 85136	4.51	0.32	4.3	2.48	70	32
Ohio 8560	4.71	0.29	4.8	2.34	73	30
Ohio 8597	4.51	0.31	4.7	2.46	72	33
Ohio 85107	4.68	0.31	5.2	2.53	76	28
Ohio 85135	4.61	0.26	4.4	2.74	77	31
Ohio 85120	4.62	0.33	5.3	2.34	74	33
Ohio 85106	4.51	0.41	5.0	2.58	72	29
Ohio 85131	4.62	0.29	4.6	2.60	73	31
Ohio 85115	4.59	0.31	4.5	2.51	73	32
Ohio 832	4.60	0.31	5.2	2.60	68	28
Heinz 2653	4.34	0.34	5.1	2.46	76	31
Ohio 8575	4.70	0.34	4.6	2.54	77	30
Hunt H27266	4.39	0.31	4.5	2.39	70	31
Ohio 8556	4.32	0.33	5.5	2.60	74	28
Ohio 7870	4.52	0.33	4.6	2.44	69	35
Ohio 7814	4.50	0.39	5.2	2.38	70	30
Ohio 8576	4.43	0.33	4.4	2.67	73	32
Ohio 85123	4.62	0.30	4.8	2.49	74	29
Ohio 85138	4.59	0.29	4.3	2.32	68	33
Ohio 8572	4.60	0.31	4.4	2.70	80	29
Ohio 8588	4.40	0.29	5.1	2.72	74	28
Ohio 8555	4.37	0.37	5.0	2.55	74	29
Ohio 85112	4.51	0.32	4.8	2.65	74	31
Ohio 8567	4.50	0.37	5.0	2.71	76	31
Ohio 8558	4.78	0.24	4.6	2.35	76	31
Ohio 8599	4.54	0.32	4.8	2.40	76	33
Ohio 8553	4.58	0.29	4.2	2.48	72	30
Hunt H29856M	4.71	0.27	4.8	2.25	77	35

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